TECHNICAL EQUIPMENT REPORT NO. 5100-12

PUMPER PERFORMANCE MAINTENANCE STANDARDS

ARCADIA EQUIPMENT DEVELOPMENT CENTER
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FOREST SERVICE
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WASHINGTON, D. C.

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Arcadia Equipment Development Center

Forest Service, U. S. Department of Agriculture

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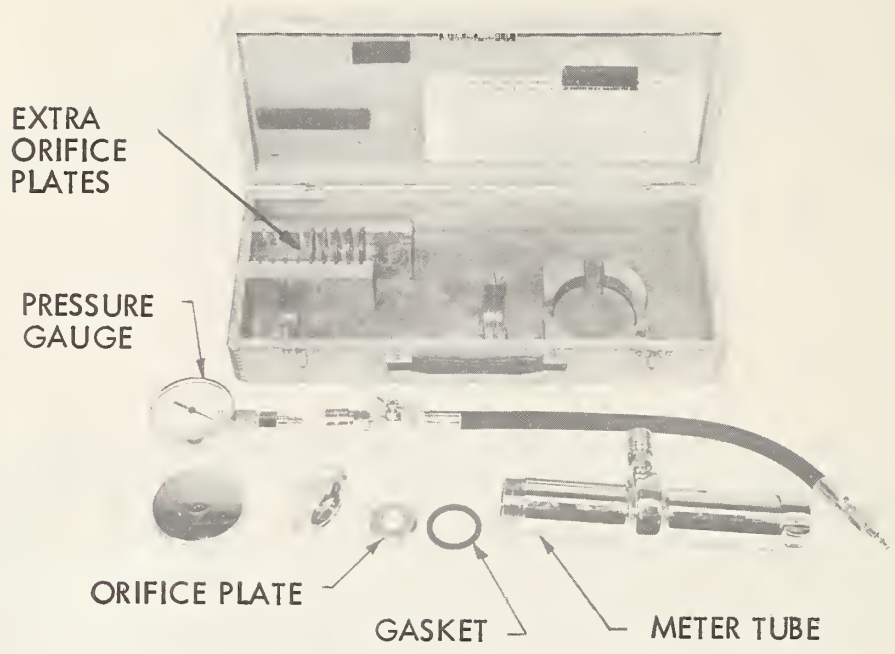
INTRODUCTION

Under TEB-532 a pumper performance kit has been designed for the California Region by the Arcadia Equipment Development Center. Minimum performance standards for maintenance have been developed for use with this kit. They cover most pumpers now in use by the Forest Service. Together they provide the Equipment Management mechanic with an accurate instrument and guide for evaluating pumper performance. It is intended to be especially useful in winter overhaul surveys as well as checking pumper trouble on the fire line.

The kit consists of a meter tube, a set of five orifice plates, a pressure gauge, and a case. In addition a blank plate is provided for use in place of an orifice plate in testing pressure gauges on the pumper. Orifice plates were chosen for their reliability and because they cannot be traded for other nozzles. Carefully machined and bored orifice plates usually vary less than two percent in flow, while nozzles may vary as much as 30 percent. Quick-connect gauge couplings are provided for convenience.

The minimum performance maintenance standards have been developed from tests conducted at Arcadia. The values given in the tables approximate the maximum continuous load which should be placed on the engine as well as leaving some performance tolerance before overhaul or replacement. The tables have a built-in feature to allow for temperature and elevation variations. Flow values (gpm) placed in the tables are general information.



PUMPER TEST KIT

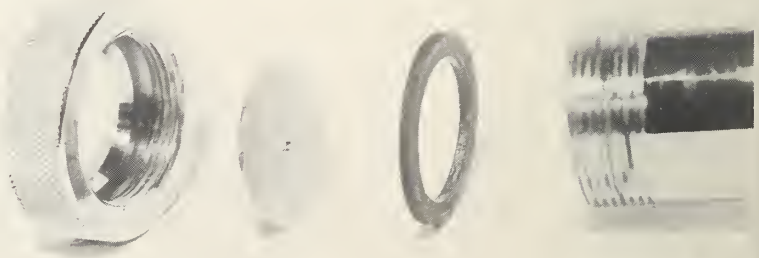
INSTRUCTIONS

1. Use full size suction line. If a tanker is not plumbed to the tank with full size waterways use overboard suction hose to outside tank.

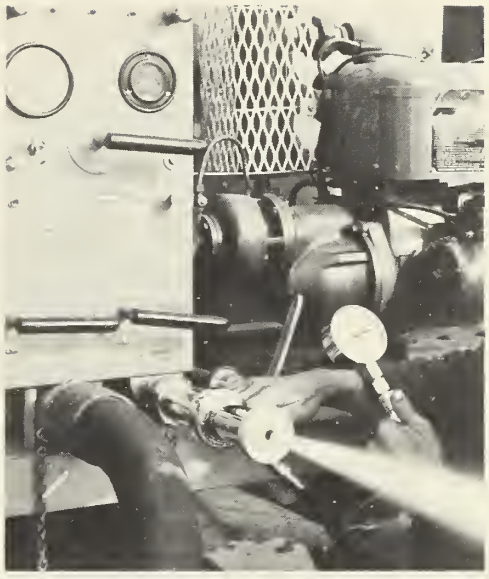
2. Open suction and discharge valves fully on lines to be used. Close all others.

3. Select proper sized orifice plate from performance table.

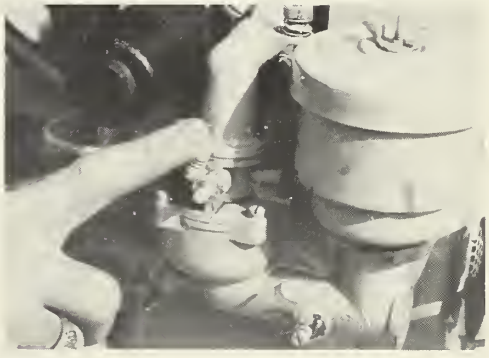
4. Install orifice plate in meter tube with beveled surfaces toward discharge side.



5. Connect meter tube assembly to discharge outlet of pumper. Do not use a long section of hose between meter tube and pumper.



6. Connect pressure gauge to meter tube.



7. Operate pumper at full throttle position. Check throttle position at carburetor for full opening.

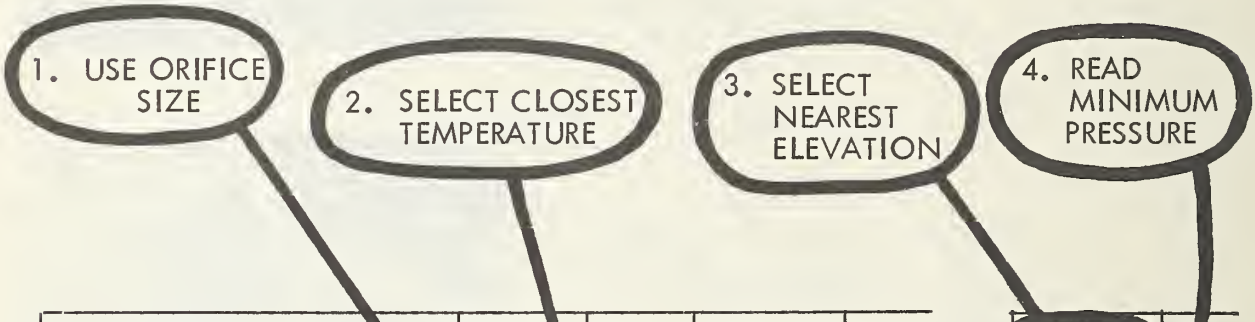
8. Gauge Pressure should equal or exceed the pressure (psi) value in the performance table for nearest temperature and elevation.

NOTE: The flow values (GPM) given in the tables are for general information only. They are not necessary under this procedure for testing pumpers.

EXAMPLE

A Hale Model HPZZ powered with a Model 23FB Briggs and Stratton engine is to be tested. The temperature is approximately 80°F and the elevation is near 3700 feet.

1. The orifice test plate size is 15/64", see (1).
2. The closest temperature in the chart is 85°F, see (2).
3. The nearest even elevation is 4000 ft., see (3).
4. When engine is operated at full throttle the gauge pressure should equal or exceed 182 psi, see (4).



PUMPER	Orifice Size	Temp. °F	Sea Level Elevation		1,000 Eleva		4,000 Ft. Elevation		5 000 Eleva
			PSI	GPM	PSI	M	PSI	GPM	SI
HALE HPZZ 23FB-B&S Engine	15/64"	55	209	14.1	20	.6	190	13.	185
		70	205	13.9	20	3.5	186	13.3	181
		85	201	13.8	19	3.3	182	13.2	17
		100	197	13.7	19	3.2	178	13.0	17
HALE CBP 264 cu. in. Engine	3/4"	55	328	188	3	182	299	180	
		70	322	186		180	293	178	
		85	316	185		178	287	176	
		100	310	183	3	177	281	174	
PACIFIC MARINE	15/64"	55	111	10.3	4	9.93	101	9.79	
		70	109	10.2					

PUMPER GAUGE TEST

1. Place blank plate in meter tube.

2. Start pumper and adjust speed to give pressure most commonly used. Valves should be in same position as for performance test.

3. Pumper gauge should read the same pressure as test gauge. Local policy will dictate how much tolerance is permissive before adjustment or replacement is necessary.

CARE AND CLEANING

This instrument is a precision device and should be handled with care. Accuracy depends on the sharp edge of the bore in the orifice plate and the calibration of the pressure gauge.

The bore of the orifice must be protected at all times. Any damage to the sharp edge of the bore will increase the flow rate with a resulting decrease in pressure thus causing a fictitiously low pumper performance rating. When not in use orifice plates should be kept in the slots provided. They should not be placed where anything might abrade or scratch them. Clean only with a soft cloth - never with wire wool, or cleaning compounds. If an orifice becomes damaged do not attempt to repair it - replace it with a new one.

The test gauge is a delicate instrument. Handle it as you would a pocket watch. If damaged return it to your depot or to the gauge manufacturer for repair and calibration. Have it checked for calibration at least once a year.

PUMPER PERFORMANCE STANDARDS

PUMPER	Orifice Size	Temp. °F.	Sea Level		1,000 Ft. Elevation		2,000 Ft. Elevation		3,000 Ft. Elevation		4,000 Ft. Elevation		5,000 Ft. Elevation		6,000 Ft. Elevation		7,000 Ft. Elevation		8,000 Ft. Elevation		9,000 Ft. Elevation		10,000 Ft. Elevation		Temp. °F.
			PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	
JOHN BEAN 101 FD	1/8"	55	351	5.31	343	5.25	335	5.18	328	5.13	320	5.06	312	5.00	304	4.93	296	4.87	289	4.81	281	4.75	273	4.68	55
		70	344	5.25	336	5.19	328	5.13	321	5.07	313	5.01	305	4.94	297	4.88	289	4.81	282	4.76	274	4.69	266	4.63	70
		85	337	5.20	329	5.13	321	5.07	314	5.01	306	4.95	298	4.88	290	4.82	282	4.76	275	4.70	267	4.64	259	4.57	85
		100	331	5.15	323	5.09	315	5.02	308	4.97	300	4.90	292	4.84	284	4.77	276	4.71	269	4.65	261	4.59	253	4.52	100
BERKELEY 1-1/2 TQ-4 AEND Wisconsin Engine	11/32"	55	183	28.6	179	28.3	175	28.0	170	27.6	166	27.2	162	26.9	158	26.6	154	26.3	149	25.8	145	25.5	141	25.1	55
		70	180	28.4	176	28.0	172	27.7	167	27.3	163	27.0	159	26.7	155	26.3	151	26.0	146	25.6	142	25.2	138	24.8	70
		85	176	28.0	172	27.7	168	27.4	163	27.0	159	26.7	155	26.3	151	26.0	147	25.6	142	25.2	138	24.8	134	24.5	85
		100	173	27.8	169	27.5	165	27.2	160	26.8	156	26.4	152	26.1	148	25.7	144	25.4	139	24.9	135	24.6	131	24.2	100
BERKELEY 2EQ-4 VF-4D Wisconsin Engine	31/64"	55	173	55.3	169	54.7	165	54.0	161	53.3	157	52.7	153	52.0	149	51.4	145	50.7	141	49.9	137	49.0	133	48.5	55
		70	170	54.8	166	54.2	162	53.5	158	52.8	154	52.2	150	51.5	146	50.8	142	50.1	138	49.4	134	48.7	130	48.0	70
		85	167	54.3	163	53.7	159	53.0	155	52.4	151	51.7	147	51.0	143	50.3	139	49.6	135	48.9	131	48.1	127	47.4	85
		100	163	53.7	159	53.0	155	52.4	151	51.7	147	51.0	143	50.3	139	49.6	135	48.9	131	48.1	127	47.4	123	46.7	100
DARLEY UE2	31/64"	55	243	65.3	237	64.5	232	63.8	226	63.0	221	62.4	215	61.6	209	60.7	204	60.0	198	59.1	193	58.3	187	57.4	55
		70	238	64.6	232	63.8	227	63.2	221	62.4	216	61.7	210	60.9	204	60.0	199	59.2	193	58.3	188	57.6	182	56.7	70
		85	233	64.0	227	63.2	222	62.5	216	61.7	211	61.0	205	60.2	199	59.2	194	58.5	188	57.6	183	56.8	177	55.9	85
		100	229	63.5	223	62.6	218	62.0	212	61.1	207	60.5	201	59.6	195	58.6	190	57.9	184	57.0	179	56.2	173	55.3	100
DARLEY 1-1/4 AGE	15/64"	55	213	14.2	208	14.0	203	13.9	199	13.7	194	13.6	189	13.4	184	13.2	179	13.1	175	12.9	170	12.7	165	12.6	55
		70	209	14.1	204	13.9	199	13.7	195	13.6	190	13.4	185	13.3	180	13.1	175	12.9	171	12.8	166	12.6	161	12.4	70
		85	205	13.9	200	13.8	195	13.6	191	13.5	186	13.3	181	13.1	176	13.0	171	12.8	167	12.6	162	12.4	157	12.3	85
		100	201	13.8	196	13.6	191	13.5	187	13.3	182	13.2	177	13.0	172	12.8	167	12.6	163	12.5	158	12.3	153	12.1	100
EDWARDS L-23	11/32"	55	183	28.6	179	28.3	175	28.0	170	27.6	166	27.2	162	26.9	158	26.6	154	26.3	149	25.8	145	25.5	141	25.1	55
		70	180	28.4	176	28.0	172	27.7	167	27.3	163	27.0	159	26.7	155	26.3	151	26.0	146	25.6	142	25.2	138	24.8	70
		85	176	28.0	172	27.7	168	27.4	163	27.0	159	26.7	155	26.3	151	26.0	147	25.6	142	25.2	138	24.8	134	24.5	85
		100	173	27.8	169	27.5	165	27.2	160	26.8	156	26.4	152	26.1	148	25.7	144	25.4	139	24.9	135	24.6	131	24.2	100
EDWARDS 120	11/32"	55	242	32.8	237	32.5	231	32.1	226	31.7	220	31.3	215	31.0	210	30.6	204	30.2	199	29.8	193	29.4	188	29.0	55
		70	238	32.5	233	32.2	227	31.8	222	31.5	216	31.1	211	30.7	206	30.4	200	29.9	195	29.5	189	29.1	184	28.7	70
		85	233	32.2	228	31.9	222	31.5	217	31.1	211	30.7	206	30.4	201	30.0	195	29.5	190	29.1	184	28.7	179	28.3	85
		100	229	31.9	224	31.6	218	31.2	213	30.8	207	30.4	202	30.1	197	29.7	191	29.2	186	28.8	180	28.4	175	28.0	100
EPCO Model T	1/8"	55	203	4.01	198	3.96	193	3.90	189	3.86	184	3.80	179	3.75	174	3.69	169	3.64	165	3.59	160	3.54	155	3.48	55
		70	199	3.97	194	3.91	189	3.86	185	3.81	180	3.76	175	3.70	170	3.65	165	3.59	161	3.55	156	3.49	151	3.44	70
		85	195	3.92	190	3.87	185	3.81	181	3.77	176	3.71	171	3.66	166	3.60	161	3.55	157	3.50	152	3.45	147	3.39	85
		100	191	3.88	186	3.82	181	3.77	177	3.72	172	3.67	167	3.61	162	3.56	157	3.50	153	3.46	148	3.41	143	3.35	100
HALE HPZF THD Wisconsin Engine	11/32"	55	253	33.6	247	33.2	242	32.8	236	32.4	231	32.1	225	31.6	219	31.3	214	30.9	208	30.5	203	30.1	197	29.7	55
		70	248	33.2	242	32.8	237	32.5	231	32.1	226	31.7	220	31.3	214	30.9	209	30.6	203	30.1	198	29.8	192	29.3	70
		85	243	32.9	237	32.5	232	32.1	226	31.7	221	31.4	215	31.0	209	30.6	204	30.2	198	29.8	193	29.4	187	28.9	85
		100	239	32.6	233	32.2	228	31.9	222	31.5	217	31.1	211	30.7	205	30.3	200	29.9	194	29.4	189	29.1	183	28.6	100

PUMPER PERFORMANCE STANDARDS

PUMPER	Orifice Size	Temp. °F.	Sea Level		1,000 Ft. Elevation		2,000 Ft. Elevation		3,000 Ft. Elevation		4,000 Ft. Elevation		5,000 Ft. Elevation		6,000 Ft. Elevation		7,000 Ft. Elevation		8,000 Ft. Elevation		9,000 Ft. Elevation		10,000 Ft. Elevation		Temp. °F.
			PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	PSI	GPM	
HALE HPZZ 23FB-B&S Engine	15/64"	55	209	14.1	204	13.9	199	13.7	195	13.6	190	13.4	185	13.3	180	13.1	175	12.9	171	12.8	166	12.6	161	12.4	55
		70	205	13.9	200	13.8	195	13.6	191	13.5	186	13.3	181	13.1	176	13.0	171	12.8	167	12.6	162	12.4	157	12.3	70
		85	201	13.8	196	13.6	191	13.5	187	13.3	182	13.2	177	13.0	172	12.8	167	12.6	163	12.5	158	12.3	153	12.1	85
		100	197	13.7	192	13.5	187	13.3	183	13.2	178	13.0	173	12.8	168	12.7	163	12.5	159	12.3	154	12.1	149	11.9	100
HALE CBP 264 cu. in. Engine	3/4"	55	328	188	321	186	314	184	306	182	299	180	292	178	285	176	278	173	270	171	263	168	256	166	55
		70	322	186	315	184	308	182	300	180	293	178	286	176	279	174	272	171	264	169	257	166	250	164	70
		85	316	185	309	183	302	181	294	178	287	176	280	174	273	172	266	169	258	167	251	164	244	162	85
		100	310	183	303	181	296	179	288	177	281	174	274	172	267	170	260	167	252	165	245	162	238	160	100
PACIFIC MARINE B. E. or Western Fire 14 x 120	15/64"	55	111	10.3	109	10.2	106	10.0	104	9.93	101	9.78	99	9.67	97	9.57	94	9.42	92	9.31	89	9.15	87	9.06	55
		70	109	10.2	107	10.1	104	9.93	102	9.83	99	9.67	97	9.57	95	9.47	92	9.31	90	9.21	87	9.06	85	8.95	70
		85	107	10.1	105	9.98	102	9.83	100	9.73	97	9.57	95	9.47	93	9.37	90	9.21	88	9.11	85	8.95	83	8.85	85
		100	105	9.98	103	9.88	100	9.73	98	9.62	95	9.47	93	9.37	91	9.26	88	9.11	86	9.01	83	8.85	81	8.75	100
PACIFIC MARINE Type S Salsbury Engine	15/64"	55	291	16.6	284	16.4	278	16.2	271	16.0	265	15.8	258	15.6	251	15.4	245	15.2	238	15.0	232	14.8	225	14.6	55
		70	285	16.4	278	16.2	272	16.0	265	15.8	259	15.6	252	15.4	245	15.2	239	15.0	232	14.8	226	14.6	219	14.4	70
		85	279	16.2	272	16.0	266	15.8	259	15.6	253	15.4	246	15.2	239	15.0	233	14.8	226	14.6	220	14.4	213	14.2	85
		100	274	16.1	267	15.9	261	15.7	254	15.5	248	15.3	241	15.1	234	14.9	228	14.7	221	14.5	215	14.3	208	14.0	100
PACIFIC MARINE GA-8	15/64"	55	263	15.7	257	15.6	251	15.4	245	15.2	239	15.0	233	14.8	227	14.6	221	14.5	215	14.3	209	14.1	203	13.9	55
		70	258	15.6	252	15.4	246	15.2	240	15.0	234	14.9	228	14.7	222	14.5	216	14.3	210	14.1	204	13.9	198	13.7	70
		85	253	15.4	247	15.3	241	15.1	235	14.9	229	14.7	223	14.5	217	14.3	211	14.1	205	13.9	199	13.7	193	13.5	85
		100	248	15.3	242	15.1	236	14.9	230	14.7	224	14.5	218	14.4	212	14.2	206	14.0	200	13.8	194	13.6	188	13.4	100
PACIFIC MARINE WA-7	15/64"	55	263	15.7	257	15.6	251	15.4	245	15.2	239	15.0	233	14.8	227	14.6	221	14.5	215	14.3	209	14.1	203	13.9	55
		70	258	15.6	252	15.4	246	15.2	240	15.0	234	14.9	228	14.7	222	14.5	216	14.3	210	14.1	204	13.9	198	13.7	70
		85	253	15.4	247	15.3	241	15.1	235	14.9	229	14.7	223	14.5	217	14.3	211	14.1	205	13.9	199	13.7	193	13.5	85
		100	248	15.3	242	15.1	236	14.9	230	14.7	224	14.5	218	14.4	212	14.2	206	14.0	200	13.8	194	13.6	188	13.4	100
PACIFIC MARINE WX-10	11/32"	55	201	30.0	196	29.6	192	29.3	187	28.9	183	28.6	178	28.2	173	27.8	169	27.5	164	27.1	160	26.7	155	26.3	55
		70	197	29.7	192	29.3	188	29.0	183	28.6	179	28.3	174	27.9	169	27.5	165	27.2	160	26.7	156	26.4	151	26.0	70
		85	193	29.4	188	29.0	184	28.7	179	28.3	175	28.0	170	27.6	165	27.2	161	26.8	156	26.4	152	26.1	147	25.6	85
		100	189	29.1	184	28.7	180	28.4	175	28.0	171	27.7	166	27.3	161	26.8	157	26.5	152	26.1	148	25.7	143	25.3	100

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